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Additional inventors are being named on the N/A *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

System and Method for determining a location by using multiple identifiers of access points.

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Respectfully submitted, Ting-Mao Chang

SIGNATURE _____ Date 03/06/2004

TYPED or PRINTED NAME Ting-Mao Chang REGISTRATION NO. _____ *(if appropriate)*

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Provisional Application for Patent

Ting-Mao Chang

for

SYSTEM AND METHOD FOR DETERMINING A LOCATION BY USING MULTIPLE IDENTIFIERS OF ACCESS POINTS

Background--Field of Invention

This invention relates to a system and method for determining a location by using identifiers of multiple access points. Application can further use the location to accessing location-based information and generate traffic database.

Background--Description of Prior Art

Many location based applications on mobile computer system use Global Position System (GPS) receiver to locate user's position and search for specifying information that is related to the position. The geographical related information is stored in a geo-coded database and linked to user's computer by an Internet connection. User describes the search criteria and query said database through the Internet connection. The criteria include user's position, searching area around the position, and other criteria for searching objects. Therefore, only the specifying

information at specified location is returned to user. However, GPS receiver is extra cost to user's mobile device in terms of price and power consumption.

Similar to GPS using triangular method, a wireless communication device detects the identifiers (for example, BSSID in IEEE 802.11 protocol) of nearby WLAN access points and their signal strength. Then, use the identifiers to look for the locations of said access points in a database and use their signal strength to estimate the distance between the wireless communication device and access points. Using triangular method, the location of the mobile device is then determined by the locations of the access points and their distances to the access points. However, this method needs calibration to determining the relation between distance and signal strength. This method is good for indoors because those access points are reliable and seldom moved without notice, most of the area covers by multiple access points, and come from known manufacture (therefore, the relation between distance and signal strength is predictable). However, this method is not practical for outdoors or large open space where access points are sparse and not reliable because they may be moved or shut down without notice. Sparse makes the triangulation does not work and the location of access point will seldom up to date.

Instead of specifying a precise location, such as GPS coordinates, a wireless phone might use the identifier of a near by cellular phone base station (hereafter Cell_ID) to specify a proximity location. Using the Cell_ID, the location of the base station can be determined by looking up a database. Since most of the base station has a high power antenna and setup at a fixed location. The base station provides very reliable position information. However, a base station covers a large area, for example several miles. Using a Cell_ID cannot precisely determine the location of the wireless phone handset. Using the media access control (MAC) address of an IEEE802.11b access point with small operation range might be able to identify a smaller area at where the handset is located. However, the smaller operation range access point is easy to setup, move, and

shut down. Therefore, smaller operation range access point is less reliable for identify the location of the handset.

Summary of the Invention

A system and method is provided for cross verification of multiple access points by using their proximity relationship. The present invention might further query location-based information in proximity to one or more said access points that pass said verification. The present invention includes a computer and a database (hereafter AP database). For each access point, said database stores the identification information and the operation range overlapping relationship to other access point. Said database might contain information of multiple access points that comply with different communication protocols. Said identification information can be detected from signal on wireless media. For example, said identification information of an access point includes an identifier of an access point in a communication protocol and the type of the communication protocol. Said computer receives the identification information of multiple access points that their operation range overlaps at a location. Said multiple access point may comply with the same or different communication protocols. Since access point might be setup, moved, or shut down without notice. To find said location, the present invention need to verify the consistency of said multiple access point against the information in said database. Said computer first removes the identification information that could not be found in said database. Said computer then verify the operation range overlapping relationship between the access points that exist in said database (hereafter checked access points). A operation range overlapping relationship between two checked access points is proved if the overlapping relationship is also found in said database. The more proved overlapping relationship to other checked access points a checked access point has, the more reliable the checked access point is. Therefore, the selection of the final one or more

access points is determined by said operation range overlapping relationship in said database. Also, an access point with the smaller operation range indicates a more precise location. A preferred embodiment of the present invention further considers the access point with smaller operation range when selects the final access point.

The location of some access points, for example of GSM base station or IEEE802.11 access points of some partner hot-spot operators, is very reliable. In another embodiment, the access points in said database are given a score of trustability. The determination of final access point might further consider the factor of said score.

To each access point, said database might further associate the location-based information that is in proximity to the location of the access point. Said location based information, for example, includes GPS coordinates, a street address, a street map, a merchant, a store, a service, merchandise, a thing, an event, or a person, etc. Therefore, said computer might further receive the property criteria of search object and the number of search objects needed. To searching location-based information, a preferred embodiment of the present invention first visit said final access point and then other operation range overlapped access points in said database in an order from smaller operation range access point to larger one. When visiting each access point, said computer selects the location-based information that associates with the visiting access point and qualifies with said property criteria. Said computer continue visiting other overlapped access point until either the number of search object is meet or no more overlapped access point.

As previous described, user sends said computer the identification information of multiple access point and property criteria of search objects. Said computer performs verification of said multiple access point and searches objects that meet the criteria, and returns the information of found search objects to user. In another embodiment, the present invention further combines the database construction with the process of location-based information query. For the received

identification information that is new to the said database, the embodiment stores the new identification information and the new operation range overlapping relationship to other received access point in said database. However, the new information may not be reliable. In order to keep the impact of new information as low as possible, the embodiment keeps a count for each element of said new information, i.e. the identification information and related operation range overlapping relationship. Said count increases once if the new information is indicated in another query. Said embodiment may not publish said new information until said count reaching certain number.

As described previously, the operation range of multiple access point designated by said multiple identification information is overlapped in a location. However, many use of the present invention may detect said identification information of multiple access point while driving or moving. Therefore, said multiple access points may form multiple overlapped groups depending on the moving speed and sparseness between access points. An embodiment of the present invention might further receive the detecting order for the identification information of multiple access points. If multiple final access points are found, said embodiment might select one of the final access points according to said detecting order, for example the earliest one in said detecting order. If there is no final access point found, the embodiment applies an indirect verification to prove the proximity relationship between checked access points. In said indirect verification, the first checked access point is proved to close to the second checked access point if there exist one or more intermediate access points in said database such that the operation range of the first checked access point contacts with the operation range of said intermediate access points and one by one finally contacts to operation range of said second access point. Said embodiment, therefore, selects the final access point that has operation range is proved indirectly contacting with other checked access point and with the fewest intermediate access point. In yet another embodiment of the present invention, said computer might receive a detecting timestamp with the

identification information of each of received multiple access point. If multiple final access points are found after said verification process, said embodiment might select one of the final access points according to said detecting time, for example the earliest detected access point. With the detecting timestamp, said embodiment might decide to stop verifying the proximity between two checked access point if the time difference between two timestamps of checked access point is too long. Said embodiment might further use the detecting timestamps to build up the street traffic that is in proximity to the locations of received multiple access points.

To associate location-based information to an access point, user need to send the identification information of nearby access points and the location-based information to computer. Similar to query, said computer first verify the access points and then store or update received identification information of checked access points in said database and associates said location-based information to checked access point.

In one embodiment, the information of an access point includes the identifier and at least one location of the access point. Said location might be a position coordinates in a referencing system, for example GPS coordinates. Said identifier of an access point is an identifier that designates said access point in a data link layer of a network protocol. Said network protocol is defined in ISO OSI network protocol reference model. For example, said data link layer includes a media access control sub layer protocol and said identifier is a media access control (MAC) address, for example BSSID in IEEE802.11 protocol, or a service set identifier (SSID) of said access point in a IEEE802.11 protocol. The location of an access point can be indexed in said database by given the identifier of the access point. By given a location and a default or given search area, said database can retrieve identifiers of access points in proximity to said search area. Said access point might complied with any proprietary or industrial standard wireless communication protocols, such as IEEE802.11 a/b/g, GSM, GPRS, CDMA, BlueTooth, etc. In an embodiment, said database contains information of multiple access points that comply with multiple different

protocols. Therefore, the information of access point might further contain the information of communication protocol type.

The traditional location-based information search is to search information object that related to an absolute location, such as the GPS coordinates. In the traditional geo-coded database, each search object is associated with a location or coordinates. In an embodiment of the present invention, an access point in said database might associate with a location, for example GPS coordinates, of the access point. The embodiment might use said location to query said traditional geo-coded database for the location-based information in proximity to said location.

With the coordinates of access point, the embodiment can further use coordinates of access point to verify the proximity relation between the access points specified by received multiple identification information. In another embodiment of present invention, multiple final multiple access points are divided into one or more location groups. The distance between any two members of a said location group is under a distance limit. Said distance limit can be a default value, for example the wireless operation range of access point, or can be configured by user. The representative location of a location group (hereafter group location) can be derived from locations of its members, for example at the center of smallest circle that covers operation range of all its members. Since the location of an access point in said database may not be up to date, the present invention selects a preferred group for determining the final location. For example, the preferred group is the largest group and its group location is the final location. In another example, user trusts some of access points and their locations are trustable. Therefore, the group related to the largest number of trust identifier is selected. If there are multiple preferred groups, the present invention might select multiple final locations or returns an error, depending on user's preference.

In yet another embodiment, the computer receives a series of identifiers that are identifiers of multiple access points detects at several locations along a moving path. The order of said series of identifiers is equal to or related to the detecting order of access points along the moving path. The locations of said multiple access points are indexed in said database by using said identifiers. As described in previous embodiment, locations of said multiple access points are divided into one or more location groups according to a distance limit. The present invention further partitions the location groups according to the group location and some criteria. For example, the criteria limit the distance between any two members in a partition. The criteria can be configured by user or can be a default value. A location of a said partition can be determined from the locations of its members, for example the location of an earliest detected identifier in said partition or the location of an earliest trusted access point. The present invention selects a preferred partition for determine the final location. The final location is the location of the preferred partition. For example, a preferred partition is the partition that contains the largest number of groups or is related to the largest number of identifiers. User may trust some access points and their locations are trustable. Therefore, a preferred partition might be the partition related to the largest number of trusted access points. If there are multiple choices, the present invention may returns locations of multiple preferred partitions or returns an error, depending on user preference. In another embodiment, each identifier in said series of identifiers is associated with a detecting time to indicate the time that said identifier was detected. With the detecting time for each identifier, maintaining the detecting order of identifiers is optional. The embodiment is not only able to determine the final location but also to calculate the velocity of user who detects said series of identifiers by using the time and location information of two identifiers in the largest partition. Therefore, the present invention can build a street traffic database at the time serving the location-based information inquiry.

In another embodiment, said location of an access point in said database further associates with time information to indicate the time that said identifier was found in said location. Therefore, said access point database provides location history of access points. The embodiment provides an identifier exchange service that exchange old identifier in a location with the current identifier in the same location. For example, said computer receives an identifier and a detecting time, search the location of said identifier at said detecting time in said database, and find the current identifier at said location in said database. For example in previous embodiments, said received identifier by said computer is further associated with a detecting time. For each received identifier, the old location of each said access point at said detecting time is found in said database instead of the current location. The present invention then further uses the method in previous described embodiment to determine the final location and find the location-based information in proximity to said final location. Since said receiving identifiers was detected sometime ago, user may want to find the current identifiers in the same location represented by the previous detected identifiers. Therefore, the present invention can use the final location to retrieve current identifiers in proximity to said final location.

Other than just find the final location related to multiple identifiers, previous described embodiments of the present invention might further continue with location-based information inquire in proximity to the final location. The request might specify some search criteria, such as the range of search area to said location and the characteristic of information. The location-based information related to a location might be information of address, things, events, and persons at nearby location. Therefore, the present invention might further query a geo-coded database for retrieving said location-based information.

Since said access point database is not always up to date and the received information may suggest or imply the updated location information of access point. The present invention can further use the received information to update said access point database. For example, for the

received identifier that is not current in said access point database, store the identifier and associates with the final location in said access point database. For the received identifier that is not proximity to said final location, associate the identifier with said final location in said access point database. Since the received information is not highly trustable, the present invention might further associate statistic information with the location of an identifier in said access point database. For example, a location of an identifier might be given a reference count to indicate the number of location inquiries that imply the identifier is at said location. If the identifier is implied in an associated location in more than 50 location inquiries, the associated location become a trusted location for said identifier and is valid for determining a final location.

The user of the present invention uses a wireless communication interface (WCI) to detect access points in nearby. A WCI usually implements at least the physical layer and Media Access Control (MAC) sub layer protocol stacks. Said WCI intercepts or scans the message on wireless media and decode one or more identifiers in MAC sub layer or data link layer data frame. User use said WCI or other networking interface to establish a link, for example Internet connection, to said computer. User then sends one or more identifiers of (nearby) access points (AP) that are currently detected to the computer through said link. Said database is hard to be up to date because new AP could be added, AP might move from one place to another, and AP might be shut down by anyone at any time. The present invention uses multiple identifiers to identify a location has higher chance of successful rate.

Drawing Figures

A system and method for accessing geographical related object by using multiple identifiers of access points is provided. In the following description, for purpose of explanation, numerous

of specific details are set forth in order to provide a thorough understanding of the present invention.

FIG. 1 shows a computer system compatible with some embodiments of the present invention.

FIG. 2 shows a user use a PDA with an IEEE802.11b wireless network interface to collect identifiers of nearby APs at a fix location.

FIG. 3 shows a user use a PDA with an IEEE802.11b wireless network interface to collect identifiers of nearby APs while driving on the road..

Description

As used herein, a "search object" refers to an object for which a user seeks information and which is geographically located in an area specified by the user. A search object typically includes a piece of a thing, a service, an event, or a person.

In general, access point is a communication node that wirelessly communicates with multiple client nodes. Access point might operate in two modes, infrastructure mode and Ad-hoc mode. In infrastructure mode, an access point bridges the wireless media to wire media, therefore, client node can connect to Internet. Since connecting to wire media, an access point in infrastructure mode usually installed at a fixed location. The preferred embodiment of the present invention uses multiple access points in infrastructure mode to indicate the location in proximity. Each access point has an identifier in the data link layer of a network protocol. Said network protocol is defined in ISO OSI network protocol reference model. For example, said data link layer might include a media access control sub layer protocol and said identifier is a media access control (MAC) address, for example BSSID in IEEE802.11 protocol, or a service set identifier (SSID) of

said access point in a IEEE802.11 protocol, or Cell_ID of base station in GSM network. Said access point might complied with any proprietary or industrial standard wireless communication protocols, such as IEEE802.11 a/b/g, GSM, GPRS, CDMA, BlueTooth, etc. User uses a wireless communication interface (WCI) to detect access points in nearby. A WCI usually implements at least the physical layer and Media Access Control (MAC) sub layer protocol stacks. Said WCI intercepts or scans the message on wireless media and decode one or more identifiers in MAC sub layer or data link layer data frame. User might use a mobile computer, such as notebook computer, personal digital assistant (PDA), or wireless phone, that integrate with multiple WCIs with different communication protocols to detect different type of access points.

FIG. 1 illustrates an example of a programmed computer 0100 (hereafter "System") for storing and retrieving information relating to access points in accordance with some embodiments of the present invention. The System 0100 is generally implemented using any conventional general-purpose computer having conventional computer components, including at least one processor 0101, program memory 0102, a communication device 0103, and a database 0104 for storing the information of access points. In one embodiment, the System 0100 further includes at least one database 0105 for storing the location-based information relating to the search objects. In some embodiments, the System 0100 is programmed with system application program 0106 (the program is illustrated for purposes of simplicity as loaded in program memory 0102) causing the System 0100 to operate as an information server implementing the various processes of the present invention.

Said database 0104 stores the information related to access points. The information related to an access point includes the identification information of the access point and the operation range overlapping relationship to other access point in said database 0104. The identification information might include the identifier of the access point in a communication protocol and the type of protocol. The identifier of an access point might be the communication node identifier in

a communication protocols, for example media access control address or Cell_ID. Every access point has an operation range that might be different from others or other type of access point. For example, standard IEEE802.11b access point is 300 foot and GSM base station operational range is couple miles. The operation ranges of two access points are overlapping if said identification information from two access points can be detect on wireless media at the same location. Each access point in said database 0104 can further associate with other information in proximity. The information related to an access point in said database 0104 can be indexed by using the identification information of the access point.

Instead of using absolution location, such as GPS coordinates to, to refer to a location, user of the present invention uses the identification information of multiple access points to indicate a nearby location and further access to the location-based information related to said multiple access point. However, old access point might be shut down or moved and new access point may be installed without notice. The information related to access point in said database 0104 might not be up to date. Therefore, said identification information of multiple access points need to be verified before using them to access other information. The present invention first check said multiple access points in said database 0104 by using their identification information. The access point that cannot be indexed in said database 0104 by using its identification information is a new access point. The rest of said multiple access points can be found in said database 0104 are the checked access points. The present invention further verifies the operation range overlapping relationship between said checked access points in said database 0104. The operation range overlapping relationship between two access points can be indexed in said database 0104 by given identification information of said two access point. Since multiple access points seldom moved from one location to another together. If said database 0104 doesn't aware that an access point is moved to a new place, the operation range overlapping relationship between the moved access point and other checked access point are less likely to be found in said database 0104.

Therefore, the more overlapping relationship to other checked access points found in said database 0104, the more reliable the access point is.

FIG 2 shows five access points, AP 0201 to 0205, have operation range overlapping at location 0206. AP 0201 is a GSM base station and AP 0202 to 0205 are IEEE 802.11b access points. User 0207 has a PDA with both GSM modem and IEEE 802.11b network interface card. The Gell_ID ID21 of AP 0201 and MAC address ID22 to ID25 of AP 0202 to 0205 are detected at location 0206. The identification information of said multiple access points are GSM Cell_ID ID21, IEEE802.11 MAC address ID22, ID23, ID24, and ID25. User sends the identification information of multiple APs to a computer 0207 with search criteria for querying 3 nearby post offices. Since AP 0202 is a new access point, MAC address ID22 cannot index any access point record in said database 0104. AP 0203 is moved to location 0206 just recently, therefore, no operation range overlapping relation between AP 0203 and any of AP 0201, 0204, and 0205 is found in said database 0104. There pairs of operation range overlapping relationships, (AP 0201, AP 0204), (AP 0201, AP 0205), and (AP 0204, AP 0205) is found in said database 0104. Therefore, each of AP 0201, 0204, and 0205 is proved to have two operation range overlapping relationships to two other detected APs. Since IEEE802.11b has smaller operation range than GSM base station, the embodiment prefers the small operation range AP and selects AP 0204 and 0205 as final APs. AP 0204 is an access point of a partner hot-spot operator and therefore is given a higher trust. AP 2004 also associates with GPS coordinates. Therefore, computer 0207 query geo-coded database 0208 with said GPS coordinates and said search criteria. Computer 0207 further annotate found post offices on a map and send the map to user. In another embodiment, location-based information directly associates with access point record in database 0104. To collect location-based information, computer 0207 might first visit said final AP, then operation range overlapped AP in same protocol, and then other AP that is overlapping with visited AP.

The embodiment might also go directly to larger operation range AP, for example AP 0201, to collect location-based information.

Since said access point database is not always up to date and the received information may suggest or imply the updated location information of access point. The present invention can further use the received information to update said database 0104. For example, AP 0202 is new to said database 0104. The preferred embodiment creates a new access point record with identification information IEEE802.11 MAC address ID22 and creates operation range overlapping relationships to each record of AP 0201, 0203, 0204, and 0205. The information of AP 0203 is out of date in database 0104. The preferred embodiment also creates operation range overlapping relationships with each record of AP 0201, 0202, 0204, and 0205. Since the received information is not highly trustable, the present invention might further associate statistic information with newly created AP record and their operation range overlapping relationship. Said statistic information counts the number of inquiry that implies such relationship between access points. The embodiment might not publish said new information until said statistic information satisfies with certain value, for example 50 inquires. Similarly, the embodiment might reduce said statistic information of moved AP, for example AP 0203, and decide to move into unreliable category when said statistic information is lower than certain value.

Instead of using operation range overlapping relationship to verify access point, some embodiments of the present invention might use the distance between access points to verify access points. FIG 3 shows three APs, AP 0301, 0302, and 0303, in proximity to User1. User1 intends to search for nearby restaurants by pressing a special programmed function key on his Personal Digital Assistant (PDA) that includes an IEEE 802.11b wireless interface card. After pressing the key, the wireless interface card scan for BSSID of nearby APs. At user's location, the identifiers, ID31 of AP 0301, ID32 of AP 0302, and ID33 of AP 0303 are detected. The PDA establishes a connection to AP 0301 through said wireless interface card. AP 0301 is connected to

a computer through the Internet. PDA then send the detected identifiers to the computer through AP 0301. Said computer receives ID31, ID32, and ID33 and retrieves their locations, Loc31, Loc32, and Loc33, correspondingly from the access point database. AP 0303 is moved to user's current location recently from a previous location Loc33 that is currently stored in the access point database. Therefore, Loc31 is closed to Loc32 within 30 meters distance but Loc33 is 2000 meters far away from either Loc31 or Loc33. For the locations that are less than 50 meters apart, put them in a group. These locations, therefore, are divided into two groups, G1 and G2. G1 includes Loc31 and Loc32. G2 includes Loc33. Computer then picks the largest group G1 and ignores G2. A location Loc34, between Loc31 and Loc32, is then choosing as the final location. Computer then queries a geo-coded database with criteria for the restaurant and search area related to location Loc34. The query results are then send back to user1.

FIG 4 shows multiple IEEE802.11b APs, 0401, 0402, 0403, 0404, and 0405, along a road and user2 drives on the road. User2 intends to search for gas stations nearby by speaking a voice command to a GPRS wireless phone that is integrated with an IEEE802.11b wireless network interface. After giving the command, the identifiers ID41 of AP 0401, ID42 of AP 0402, ID43 of AP 0403, ID44 of AP 0404, ID45 of AP 0405 are detected along the road by the wireless network interface. The GPRS wireless phone is connect to Internet through GPRS phone network. Therefore, the detected identifiers are transmitted to a computer through GPRS network and the Internet in the sequence of ID41, ID42, ID43, ID44, and then ID45. The computer then retrieves their locations, Loc41 for AP 0401, Loc42 for AP 0402, Loc43 for AP0403, and Loc44 for AP 0404, by querying the access point database. Since, AP 0405 is a recently moved from a previous location Loc45 that is currently stored in the access point database. The distance between Loc41 and Loc42 is 20 meters. The distance between Loc43 and Loc44 is 30 meters. The distance between Loc42 and Loc43 is 250 meters. To group locations that are less than 100 meters apart, Loc41 and Loc42 are assigned to group G41. Loc43 and Loc44 are assigned to group G42. Loc45

is assigned to group G43. To further partition groups, the groups that are 400 meters apart are put in the same partition. G43 is 2000 meters away from both G41 and G42 and G41 is partitioned into partition P41. The distance between G41 and G42 is about 250 meters and are partitioned into partition P42. Since P42 is largest partition, the location of P42 is the final location. The location of P42 is Loc41 that is the location of the first identifier in the receiving sequence. The computer further queries a geo-coded database for retrieving gas stations in proximity to Loc41. Then, the computer returns the query result back to user2. Computer can further query a map database to retrieve the local street map, annotates found gas stations on the map, and returns the map to user2. In another embodiment, ID41, ID42, ID43, ID44, ID45 are associates with detecting time T41, T42, T43, T44, and T45. The detect order can be determined from the detect time without rely on its receiving sequence. The embodiment not only queries the location-based information for user but also constructs street traffic database. The detecting time indicates that user travel from Loc41 at T41 to Loc44 at T44. The average velocity between Loc41 and Loc44 is (Loc44 – Loc41)/(T44 – T41). By knowing the velocity at a location, the system can construct street traffic database after more location-based information inquire and in more locations.

An application records one or more identifiers of access points at a location and schedules to trigger a task when detects said identifiers in the future. However, the access points might be move to other place or new access point is moved to the location. In order to keep the identifier at that location up to date, the recorded identifier is further associated with the previous detect time. Access point record in said database 0104 might include the location history of the access point. Said history includes multiple sets of time and location of the access point. Therefore, the location of an access point at a specific time can be retrieved by given the identifier and detect time of the access point. After locations of said multiple access points is retrieved, the computer picks a representative group location. The computer then further queries access point database to

retrieve identifiers of access point currently in proximity to the group location. Then, the new retrieved identifiers are then returns to replace the old identifiers.

Conclusion, Ramifications, and Scope

The present invention uses identifiers of multiple access points, for example MAC address, to identifying a location. The present invention verifies said multiple access points by using the proximity relation, for example the operation range overlapping relationship or the distance between access points. After verification, the present invention selects one or more final access point or final location. Then, the present invention might search for location-based information according to search criteria and in proximity to selected final access point or final location. Access point database might further use information in user's inquiry to update database itself. The present invention might maintain location history of access point and provide exchange service that exchanges a set of old identification information of access points with a set of new identification information at the same location. The system of present invention can be install with in a network server that connect remotely with mobile client or directly install in mobile client.

Although the description above contains many specific details, these should not be construed as limiting the scope of the invention but as merely providing illustrations of some the possible embodiments of the invention.

Thus, the scope of the invention should be determined by the appended claims and their legal equivalents, rather than by the examples given.

CLAIMS

I claim:

1. A method for accessing location-based information by using identifiers of multiple access points comprising:

Storing at least one identifier of access point in a database,

Associating at least one location with said identifier,

Receiving multiple target identifiers,

Indexing said target identifier in said database,

Retrieving locations of said multiple target identifiers,

Grouping the locations of said multiple target identifiers into, wherein the distance between members in a group is under a limit, and

Determining a representative location of a said group that has largest number of members.

2. The method of claim 1, further comprise returning said representative location of said group.

3. The method of claim 1, further comprising:

Associating time information with each said location of said identifier in said database, and

Receiving time information related to said target identifier, wherein the location of said target identifier associates with time information that is closed to said receiving time information.

4. The method of claim 3, further comprising:

searching at least one candidate identifier in said database, wherein the current location of said candidate identifier is in proximity to said representative location of said groups, and

outputting said candidate identifier.

5. The method of claim 1, further comprising:

Receiving request for accessing to location-based information, wherein said location-based information is in proximity to said representative locations of a said group that has largest number of members, and

Outputting said location-based information.

6. The method of claim 5, further comprise receiving a range information, wherein said location-based information to said representative locations is within the range specified in said range information.

7. A method for accessing location-based information by using identifiers of multiple access points comprising:

Storing at least one identifier of access point in a database,

Associating at least one location with said identifier,

Receiving multiple target identifiers in an order,

Indexing said target identifier in said database,

Retrieving locations of said multiple target identifiers,

Grouping the locations of said multiple target identifiers, wherein the distance between members of a group is under the first limit, and

Petitioning said groups, wherein the distance between members in a partition is under the second limit,

Selecting a partition that has largest number of groups or locations, according to user's preference, and

Determining a representative location of said partition by using said order relationship.

8. The method of claim 7, further comprise returning said representative location of said group.

9. The method of claim 7, further comprising:

Associating time information with each said location of said identifier in said database, and

Receiving time information related to said target identifier, wherein the location of said target identifier associates with time information that is closed to said receiving time information.

10. The method of claim 9, further comprising:

searching at least one candidate identifier in said database, wherein the current location of said candidate identifier is in proximity to said representative location of said groups, and

outputting said candidate identifier.

11. The method of claim 7, further comprising:

Receiving request for accessing to location-based information, wherein said location-based information is in proximity to at least one said representative locations of said location groups, and

Outputting said location-based information.

12. The method of claim 11, further comprise receiving a range information, wherein said location-based information to said representative locations is within the range specified in said range information.

13. The method of claim 7, further comprising:

Receiving a time for each said target identifier, and

Calculate velocity related information by using said location and time between two of said target identifiers, and

Store said velocity related information in to a street traffic database.

14. The method of claim 13, further comprising:

Receiving request for accessing to location-based information, wherein said location-based information is in proximity to at least one said representative locations of said location groups, and

Outputting said location-based information.

15. The method of claim 14, further comprise receiving a range information, wherein said location-based information to said representative locations is within the range specified in said range information.

16. A method for accessing location-based information by using identifiers of multiple access points comprising:

Storing at least one identifier of access point in a database,

Storing operation range overlapping relationship in said database,

Receiving multiple target identifiers,

Indexing said target identifier in said database,

Filtering said multiple target identifiers with said operation range overlapping relationship,

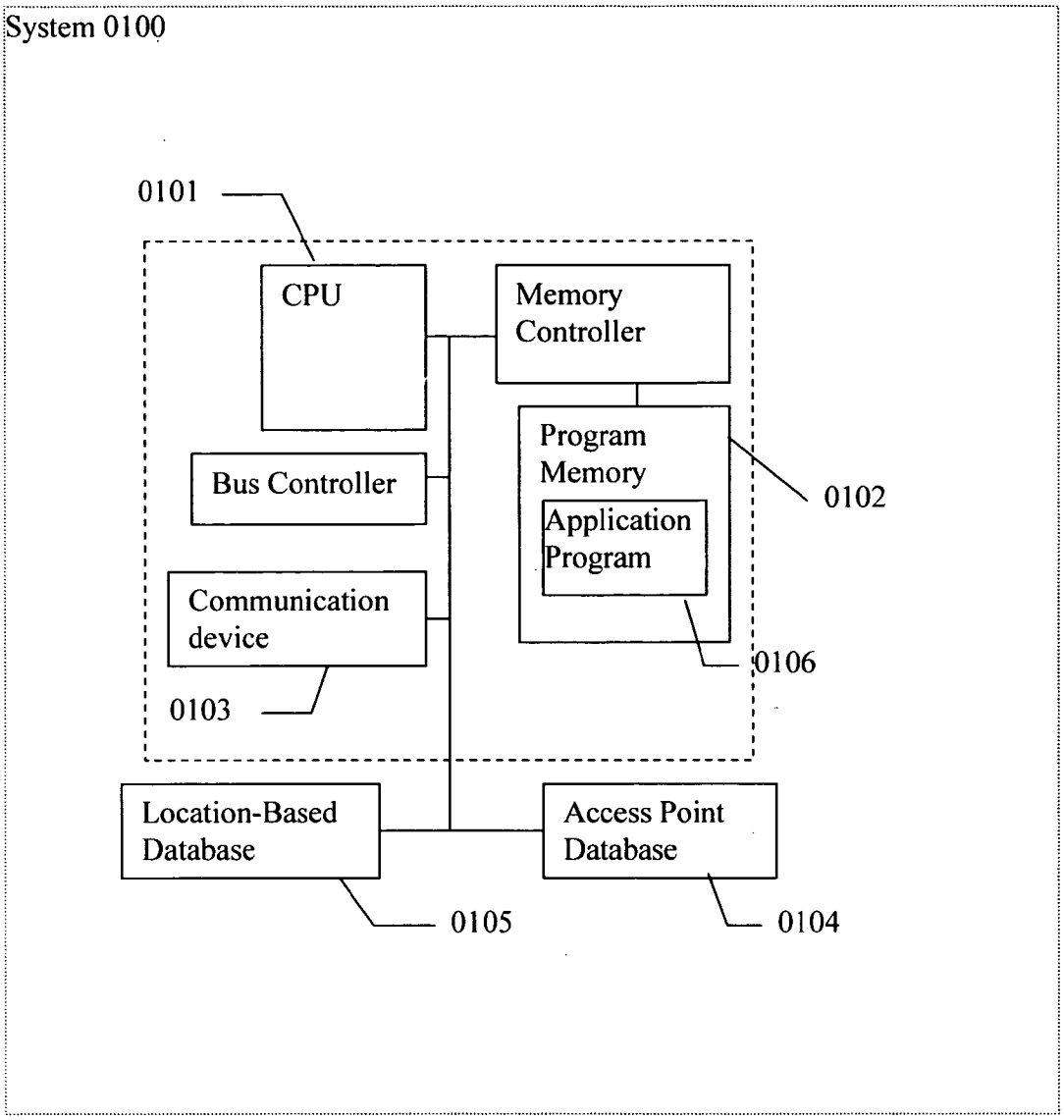
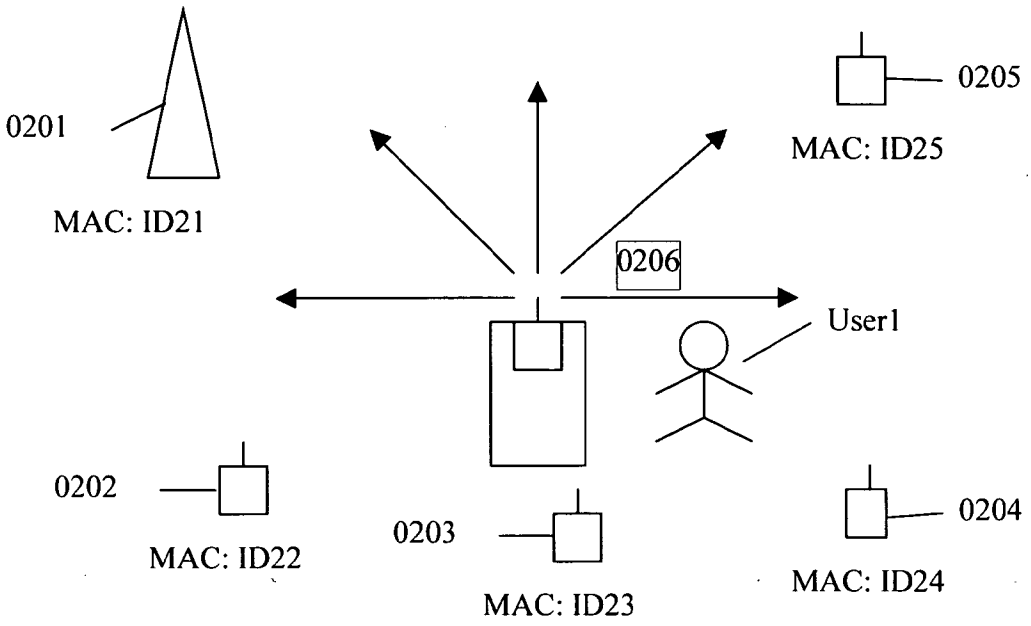

System 0100
0101
CPU
Memory Controller
Program Memory
Application Program
0102
Bus Controller
Communication device
0103
0106
Location-Based Database
Access Point Database
0105
0104

FIG 1


0201
MAC: ID21
0205
MAC: ID25
0206
User1
0202
MAC: ID22
0203
MAC: ID23
0204
MAC: ID24

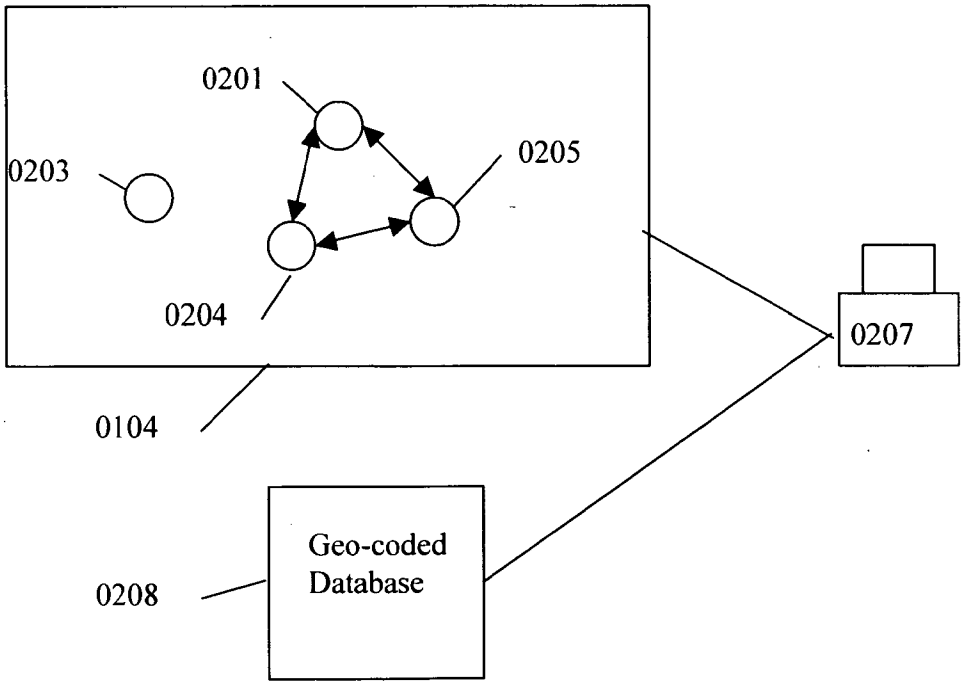
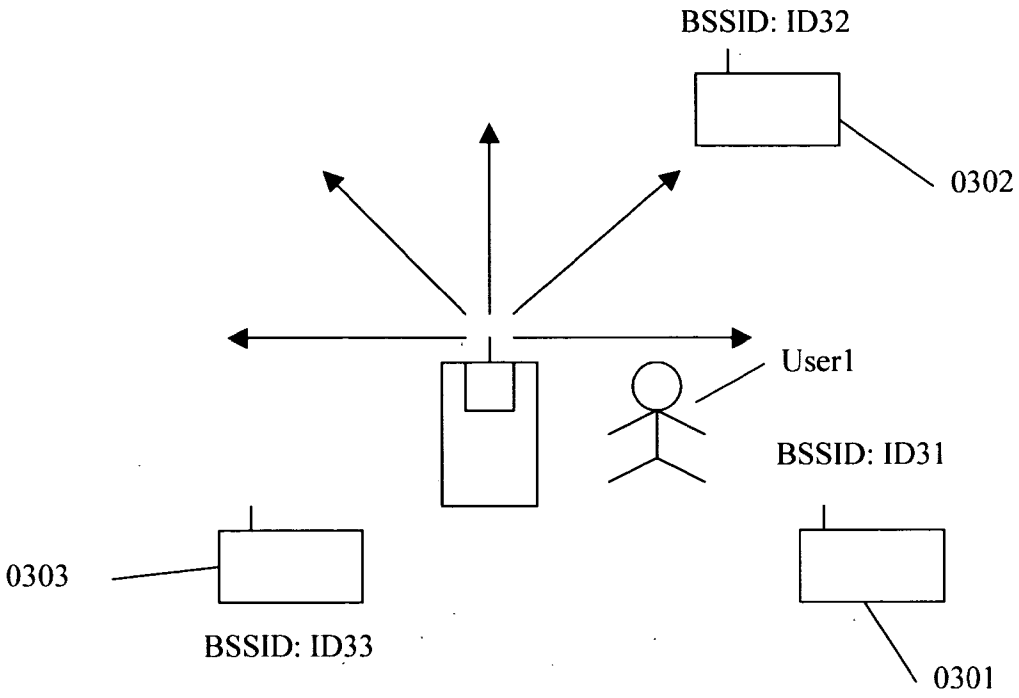

0201
0203
0205
0204
0104
0207
Geo-coded
Database
0208

FIG 2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0302
User1
BSSID: ID31
0303
BSSID: ID33
0301

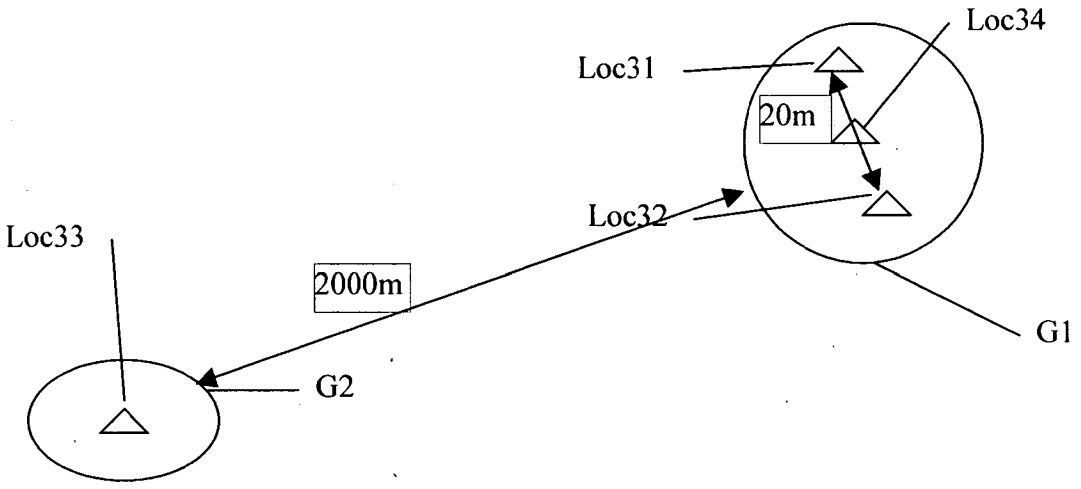
Loc34
Loc31
20m
Loc32
Loc33
2000m
G1
G2

FIG 3

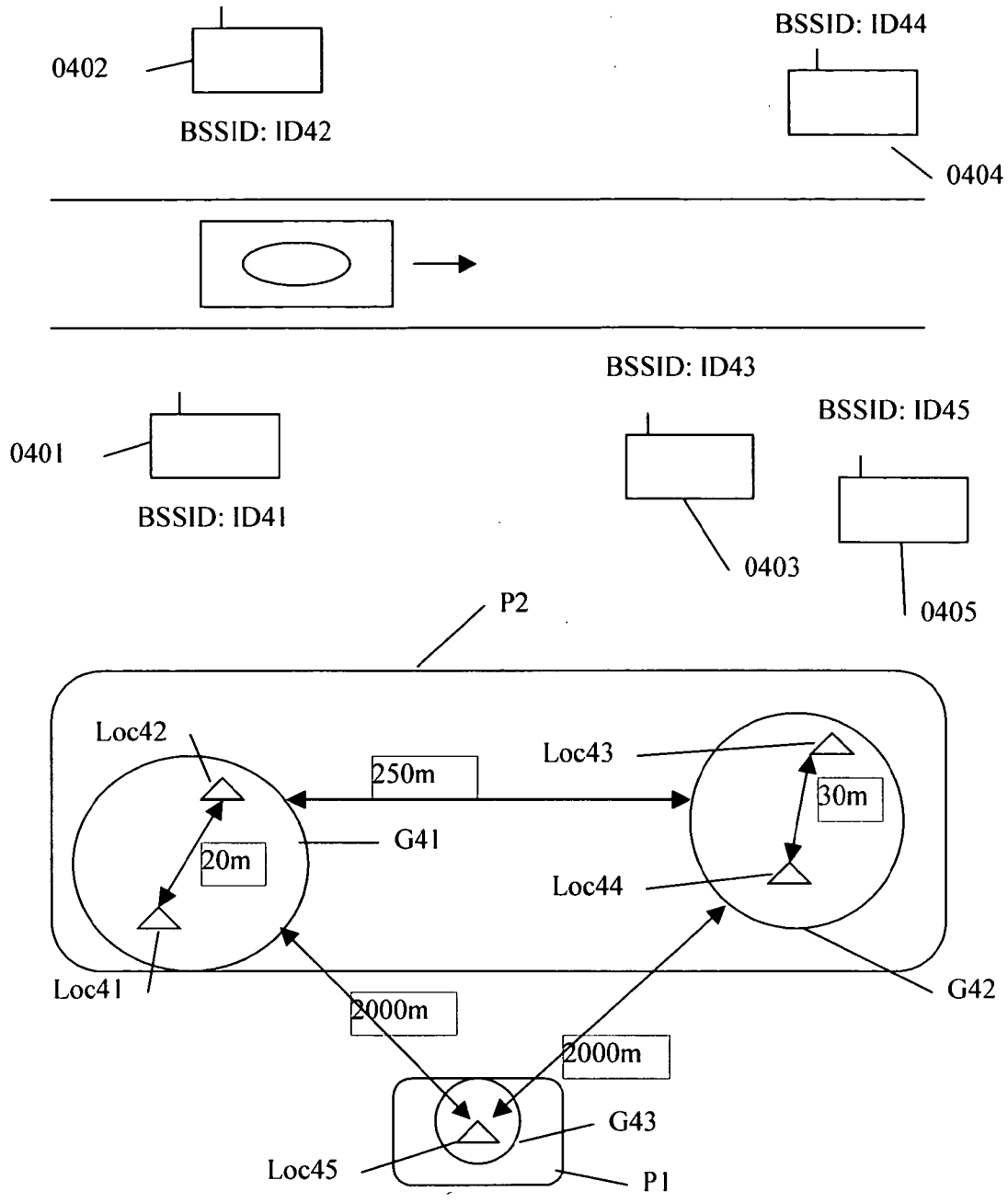
0402
BSSID: ID42
BSSID: ID44
0404
BSSID: ID43
BSSID: ID45
0401
BSSID: ID41
0403
0405
P2
Loc42
250m
Loc43
30m
20m
G41
Loc44
Loc41
G42
2000m
2000m
G43
Loc45
P1

FIG 4